

**SECTION 700—GENERAL****700.01—Description.**

These specifications cover general construction items, methods, and procedures common to traffic control devices.

**700.02—Materials.**

- (a) **Concrete** shall be Class A3 conforming to the requirements of Section 217.
- (b) **Reinforcing steel** shall conform to the requirements of Section 223.
- (c) **Paint** shall conform to the requirements of Section 231 and shall be applied in accordance with the requirements of Section 411 except on nonferrous materials where it shall be applied in accordance with the requirements of the manufacturer's recommendations.
- (d) **Galvanizing** shall conform to the requirements of Section 233.
- (e) **Electrical items** shall conform to the requirements of Section 238.
- (f) **Wood for posts and poles** shall conform to the requirements of Section 236 and shall be treated in accordance with the requirements of Section 236. Wood items shall be cut prior to treatment.
- (g) **Steel** for fabricated items shall conform to the requirements of Section 226 and shall be fabricated, welded and inspected in accordance with the requirements of Section 407.
- (h) **Aluminum** for fabricated items shall conform to the requirements of Section 229 and shall be fabricated, welded and inspected in accordance with the requirements of Section 407.
- (i) **Poles, posts, and overhead and bridge-mounted sign structures** shall conform to the following: When painting is not required, steel poles and posts shall be hot-dip galvanized after fabrication. When painting is required, steel poles and posts shall be given one shop coat of primer and two field coats of paint.

Overhead and bridge-mounted sign structures shall be hot-dip galvanized after fabrication. When painting is required, the galvanization finish of overhead and bridge-mounted sign structures shall be field treated for paint retention and two coats of paint applied.

Mast arms and lighting, signal, and pedestal poles shall be of a one-piece or sectional single unit, tubular form, and shall be round or multisided. Multisided poles shall have at least eight sides. Pole shafts and arms shall have a removable cap fastened by at least three screws.

Mast arms shall not deflect below the horizontal plane or exceed a rise of 3 percent of the arm length after loads are applied. Mast arm poles shall include an arm attachment flange plate continuously welded to the gusset and side plates. The gusset and side plates shall be continuously welded to the pole and each other. The flange shall be fabricated with four studs permanently attached for receiving nuts (attaching arm). The flange plate and pole shall have a 2 1/2-inch wiring hole with a grommet centered in the pattern.

Strain poles shall not exceed a dead load deflection of 3 percent of the distance between the base of pole and point of dead load attachment. The minimum bottom diameter of strain poles shall be 11 inches.

Lighting, signal, and pedestal poles; sign posts; and overhead and bridge-mounted sign structures shall conform to the requirements of AASHTO's *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*.

1. **Conventional and offset lighting poles** shall be steel or aluminum.
2. **Overhead and bridge-mounted sign structures, signal poles, and high-mast lighting poles** shall be steel.
3. **Pedestal poles** with a nominal diameter of more than 2 inches shall be steel or aluminum. Pedestal poles 2 inches and less in nominal diameter shall conform to the requirements of Section 238 for metal conduit.
4. **Sign posts** shall be wood or steel.

To prevent serious aerodynamic vibrations in cantilevered sign structures with variable/changeable message signs attached, Section 1.9.6 of this AASHTO specification is modified to require the critical wind speed at resonance ( $V_c$ ) to be greater than the design wind speed.

- (j) Anchor bolts shall be steel, conforming to the requirements of Section 226.02(c)2. Except when stainless steel is used, the portion of anchor bolts beginning 4 inches below the top of the foundation and extending above the foundation shall be galvanized.
- (k) **Breakaway support systems** shall conform to the requirements of AASHTO's *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*.

1. **Breakaway couplers and skirt covers** shall be aluminum. Threaded studs, nuts, and washers shall be stainless steel or galvanized steel.
2. **Frangible bases** shall be aluminum.
3. **Slip bases** shall be galvanized steel or other approved noncorrosive metal.
  - (l) **Miscellaneous hardware** shall be brass, bronze, stainless steel, or galvanized steel.

### 700.03—Working Drawings.

The Contractor shall submit to the Department working drawings, including design calculations and catalog cuts, in accordance with the requirements of Section 105 except that seven copies of each shall be submitted. Submitted data for the following aluminum lighting poles shall also specifically address how fatigue was considered in the design of the poles. Fatigue may be addressed through the use of vibration dampening devices or through other means as determined by the manufacturer.

- (a) Conventional aluminum lighting poles with a height of 40 feet or greater
- (b) Offset aluminum lighting poles with a height of 20 feet or greater
- (c) Other aluminum lighting poles with a height greater than 20 feet and a pole top mounted luminaire
- (d) All aluminum lighting poles mounted on bridges

In lieu of working drawings and catalog cuts, the Contractor may submit a letter indicating the brands, types, and models of equipment along with the approval numbers and contract item numbers. The Contractor shall include the words “Testing Required” with the approval numbers when materials testing is required for the equipment. The approval numbers shall be taken from the Department’s preapproved traffic control device list. Any equipment on the list for which approval has been rescinded will not be allowed for use if the rescinded date is earlier than the receipt of bids for the project. Inclusion of equipment on this list does not ensure acceptance if contract requirements prohibit use of the equipment. The Contractor shall ensure that the equipment as furnished conforms to the requirements of the Department.

### 700.04—Procedures.

- (a) **Ground Rods:** Ground rods shall be installed in accordance with the requirements of NEC or by other methods approved by the Engineer. Ground rods shall include a No. 6 bare copper conductor and ground rod clamps. Ground rods shall not have a resistance to ground of more than 25 ohms.

- (b) **Excavation for Foundations:** Excavation shall be performed in accordance with the requirements of Section 401.
- (c) **Concrete Foundations:** Foundations shall be constructed and cured in accordance with the requirements of Section 404 and shall rest on material that will adequately support the design load. Exposed areas of concrete foundations shall be given a Class 7 finish in accordance with the requirements of Section 404. Items shall not be erected on concrete foundations until concrete has cured for at least 28 days or has obtained a compressive strength of at least 3,000 pounds per square inch.

Foundations for overhead sign structures shall be spread footings, unless inadequate soil conditions require timber piles. Drilled foundations may be permitted except for single pole structures (overhead-single pole in end forms, cantilever, or butterfly).

Foundation designs for signal poles, high mast lighting poles and overhead sign structures shall be furnished by the Contractor. Foundations shall be designed to conform to the requirements of *AASHTO's Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*. The Contractor shall accomplish at least one test bore as approved by the Engineer at each foundation location to determine the subsurface condition prior to designing the foundation. Test bores shall be accomplished in the actual soil the foundation will be placed in and shall be performed in accordance with any of the following three methods:

1. METHOD 1—ASTM D420, ASTM D1452 and ASTM D1586
2. METHOD 2—ASTM D3441
3. METHOD 3—ASTM D4719

Depth of the test bores shall be at least 15 feet west of the fall line (I-95) and at least 30 feet east of the fall line (I-95). When test bores are accomplished in the median of I-95, the depth shall be at least 15 feet north of Route 250 and at least 30 feet south of Route 250. Soil conditions shall be tested at the ground level and then on 3 feet intervals.

When auger refusal occurs before a 15 feet depth due to rock, the rock shall be core sampled in accordance with ASTM 2113. However, rock shall be continuously cored for at least 5 feet and be sampled in accordance with ASTM 2113. Bore logs shall be properly identified to the actual site with the centerline station and the distance perpendicular from the centerline indicated. On projects where the roadway is existing and no centerline is being surveyed, alternate methods for identifying the location shall be submitted by the Contractor for the Engineer's records. Bore logs shall be provided to the Department with the shop drawing submittals for the foundation designs.

The Contractor is hereby advised the quantity of cubic yards of concrete that is indicated in the contract for the foundations is an approximation. Payment will be made for the actual cubic yards of concrete needed based upon the supplied foundation designs.

- (d) **Electrical Service:** Electrical service shall be installed in accordance with the requirements of NEC and the local power company. Meter bases and current transformer cabinets will be furnished by the local power company. The Contractor shall make arrangements with the local power company for pickup of this equipment. The Department will request and pay for electrical service and temporary electrical service for items temporarily relocated or adjusted for the purpose of traffic control shown on the plans or directed by the Engineer. If the Contractor desires temporary service for his convenience, he shall arrange and pay for the service.
- (e) **Poles, Posts, and Sign Structures:** The location of each pole, post, and sign structure shall be established by the Contractor with a stake bearing the number or identification designated on the plans. The Engineer, accompanied by the Contractor, will inspect the locations and advise the Contractor of any necessary adjustments. Poles, posts, and sign structures shall be made plumb after installation of loads by the use of nuts and flat washers above and below the base plate on each anchor bolt or by other approved methods.

If a pole, overhead sign structure, or span wire is to be located within 10 feet of an electric power line as measured in any direction, the Contractor shall immediately inform the Engineer. The Contractor shall not install the equipment until the Engineer has reviewed and advised the Contractor of any relocation or to proceed with the work.

A noncorrosive metal identification tag shall be permanently attached to each signal, pedestal, mast arm, and lighting pole, overhead sign structure, bridge mounted sign structure, and I-beam steel sign post, except U-channel sign posts, approximately 30 inches above the foundation or attachment. The tag shall be of sufficient size for 1/4-inch lettering single spaced between lines and shall be attached by noncorrosive rivets.

The tag shall be imprinted with "VDOT". All tags shall be imprinted with the manufacturer's name, the date of manufacturer, and the manufacturer's identification number that is unique for each separate item. These tags shall be installed with the ID number at the site manufacture. The unique identification number shall be shown all supporting documentation.

Additionally the following shall apply:

1. **signal poles:** gage and length of pole and mast arm(s)
2. **pedestal poles:** gage and length of pole

3. **lighting poles:** gage and length of pole and luminaire arm(s); electrical phase circuit designation except on high mast
4. **overhead sign structures:** gage and length of pole and span
5. **steel sign posts:** length, size, and weight per foot of post

When transformer bases are used, bolt covers shall be installed on pole anchor bolts. Bolt covers shall be designed to allow ventilation of the nut and anchor bolt.

Poles shall be provided with hand holes that face away from traffic. Hand holes shall be at least 3 by 5 inches and provided with a gasket and cover. The cover shall be attached to the pole with noncorrosive cap screws, and attachment holes shall be drilled and tapped.

When required by the plans, the Contractor shall supply a terminal strip consisting of 24 double-pole terminals. The terminal strip shall be constructed of noncorrosive materials and shall be located on the outside of the pole just above the hand hole. A continuously welded frame and a removable, weatherproof, gasketed cover designed to enclose both the hand hole and terminal strip shall be provided.

- (f) **Breakaway Support Systems:** Breakaway support systems shall be installed on lighting poles when required by the plans and on pedestal poles except when used for power service. Breakaway support systems shall be installed in accordance with the requirements of the manufacturer's recommendations.
- (g) **Conductor Cables:** Conductor cables in conduit runs more than 100 feet in length shall be installed with the use of an approved lubricant or pulling compound. Cleaning agents and lubricants that have a deleterious effect on cable coverings shall not be used.

Aerial cables that extend more than 20 feet shall be supported by a span wire or reinforced with a copper-clad, galvanized, or stainless steel wire for self-support. Cable rings shall be used to attach conductor cables to the supporting wire; however, lash wire may be used to attach interconnect cable when no other conductor cables are attached to the same span wire. Vinyl tape shall be used as shown on the plans to prevent sag. When aerial cables enter a service entrance head, an 8-inch drip loop shall be formed.

Bends in single or multiple conductor cables shall have a bend radius of at least 5 times the outside diameter of the cable.

Conductor cables shall be installed with the slack length coiled in junction boxes. The coiled length shall be sufficient to allow cables to extend at least 2 feet above junction boxes.

Solderless terminals shall not be used for connecting conductor cables having solid conductors to terminal posts.

Splices in lighting conductor cables will be permitted only at accessible locations. Splices in service entrance conductor cable will be permitted only for connection to the utility company's service conductor cables. Splices shall be made in accordance with the requirements of NEC. Splices will not be permitted in signal and interconnect conductor cables.

Breakaway connectors shall be installed on luminaire conductors and on signal conductors for signal head assemblies on pedestal poles. Breakaway connectors shall be fused for the hot conductors and nonfused for the grounded conductor. Breakaway connectors shall be located in the hand hole of the pole.

Signal and interconnect cable terminal strips shall be sealed with a moisture block compound to prevent moisture from entering the open cable end. The compound shall be soft, pliable, and easily removable and shall be used in accordance with the requirements of the manufacturer's recommendations.

Termination of interconnect cable will be allowed only in a master controller cabinet, local controller cabinet, or terminal enclosure. The cable shield shall be grounded at each termination point. Whenever the cable is entered for connection to equipment, each wire of the cable shall be connected to a terminal post position.

The Contractor shall conduct a Megger test on the installed interconnect cable and shield, for which a reading of 100M ohms shall be required. Testing for 300-volt cable shall be performed at 200 volts, and testing for 600-volt cable shall be performed at 500 volts. Cables shall be disconnected from controller cabinet terminals during testing.

Service entrance and lighting conductor cables shall be marked in accordance with the requirements of Article 310-11 of NEC. Markings shall be continuous and permanent. Signal and interconnect conductor cables shall be marked in accordance with the requirements of the applicable IMSA specification.

Prior to energizing an electrical system, the Contractor shall demonstrate to the Engineer that the system is clear and free from short circuits, open circuits, and unintentional grounds. Faulty circuits shall be repaired or replaced by the Contractor at his expense.

1. **Lighting conductor cables** shall be identified at accessible locations by integral-impregnated color coding, durable color-coded plastic tape, or other approved means. Color coding shall be as follows.

Circuit Designation	Color Code
Phase A or Line A	Black or unmarked
Phase B or Line B	Red or orange <sup>1</sup>
Phase C	Blue
Neutral	White or gray
Grounding	Green or bare

<sup>1</sup> For 3-phase, 4-wire delta systems, Phase B shall be the high leg and shall be orange.

2. **Signal and interconnect cable** shall be identified by integral-impregnated color coding. Color-coding for signal cable shall be as follows:

Cable Jacket Color	14/12 Cable	14/7 Cable	14/4 Cable	14/3 Cable
Red	Red	Red	Red	Don't Walk
Orange	Amber	Amber	—	—
Green	Green	Green	Green	—
Red w/black tracer	Red	—	—	—
Orange w/black tracer	Amber	—	—	—
Green w/black tracer	Green	—	—	—
Blue	Green	Green	—	—
White w/black tracer	Amber	Amber	—	—
Black	Red	Red	Amber	Walk
Black w/white tracer	Spare	—	—	—
Blue w/black tracer	Spare	—	—	—
White	AC ground	AC ground	AC ground	AC ground

Signal and interconnect conductor cable jackets shall be permanently identified in the controller cabinet and junction boxes. Signal conductor cable jackets shall also be identified in the hand hole of poles if the cables are attached to terminal strips in the hand hole. Identifications shall be indicated on nonferrous metal tags or nylon tags attached to the cable with nylon cable ties. The identification shall be stamped or engraved on the metal tags and lettered with permanent ink on the nylon tags. Identifications shall be legible and shall conform to the following:

- a. **signal cable:** phase and location of signal head; e.g., 1 NB left-turn head; 1 NB inside left-turn head; 2 SB through-lane heads; 1 left-turn head and 6 through-lane heads; 2 Ped head NW Quad

- b. **interconnect cable:** description and direction from location (if cable is a spare). The word “spare” shall be included after “inter.” The direction from location is required only in the controller cabinet, e.g., Inter. NB; Inter. Spare NB; Inter. WB; Inter.
- (h) **Conduit Systems:** PVC, fiberglass, and metal conduit runs shall have the minimum number of couplings permitted by the use of standard conduit lengths. Ends of conduit sections that must be field cut shall be reamed smooth. PE conduit shall be installed in continuous unspliced runs between enclosures. Field-threaded portions of metal conduit shall be galvanized. Except for expansion couplings, conduit sections shall be connected with couplings so that ends will abut squarely inside couplings.

Joint sealing solvent shall be used as recommended by the conduit manufacturer. Where necessary, ends of each length of nonmetallic conduit shall be tapered by machining to provide joints that are tight after assembly.

Conduits shall be continuous and watertight between outlets. Deformed conduit shall not be used. Conduits shall be free from kinks or defects that would cause damage to conductor cables when pulled. Conduits shall be installed so that moisture will drain properly to electrical junction boxes or drainage tees with drip spouts.

After installation, each conduit shall be tested in the presence of the Engineer for obstructions. A suitable rigid or flexible mandrel having a diameter at least 80 percent of the inside diameter of the conduit shall be pulled through each conduit run. Obstructions shall be removed, and the conduit repaired at the Contractor’s expense.

After testing, individual conduit runs more than 150 feet in length that are to remain empty shall be equipped with a nylon or polypropylene pull rope having a tensile strength of at least 1,000 pounds. Twelve inches of rope shall be doubled back into the conduit at each end.

Open ends of unused conduit shall be closed with watertight plugs, caps, or other seal fittings to seal them against moisture.

Wherever conduit crosses a structural expansion joint, conduit shall be provided with an expansion fitting. The fitting shall permit longitudinal movement of the amount specified on the plans.

Metal conduit systems shall be bonded. When a nonmetallic conduit system is used, the Contractor shall furnish and install a grounding conductor wire to maintain a bonded system in accordance with the requirements of NEC.

1. **Exposed conduit systems** shall be fabricated of heavy-wall PVC, fiberglass, or metal, with not more than four bends between any two

outlets. The angular sum shall be not more than 360 degrees. When heavy-wall PVC or fiberglass conduit is accessible to public contact, it shall be covered with a protective shield, conforming to the requirements of Section 238, for a distance of at least 8 feet above the adjacent finished grade. Splice boxes or pull boxes shall be of a size that will allow proper termination of conduit and connection of conductor cables as required by NEC. Conduit shall be terminated by means of approved fittings or bushings.

2. **Buried conduit systems** shall be installed in straight lines between outlets. When obstructions are encountered during installation and conduit cannot be economically located elsewhere, the obstruction shall be bypassed by offsetting the conduit line in accordance with the requirements of the standard drawings. Required conduit bends shall be installed with a bend radius of at least 5 feet. Conduit bends in structures and foundations shall be installed in accordance with the requirements of NEC. The use of a pipe tee or vice for bending conduit will not be permitted.

When conduit is to be installed under an existing roadway and open cutting is not permitted, conduit shall be installed in a pipe sleeve that has been jacked or bored in accordance with the requirements of Section 302.

Open cut areas shall be backfilled in accordance with the requirements of Section 302.

- (i) **Junction Box Covers:** If a special tool or wrench is needed to remove a cover, the Contractor shall furnish the Engineer five such tools.
- (j) **Hydraulic Cement Concrete Sidewalk:** When disturbed by the installation of equipment, sidewalk shall be replaced in accordance with the requirements of Section 504 along existing joint lines.

#### **700.05—Measurement and Payment.**

**Concrete foundations** will be measured and paid for in units of each or cubic yards of concrete, as applicable. This price shall include foundation designs, concrete, reinforcing steel, anchor bolts, bolt circle templates, stub poles, grounding equipment, conduits, excavating, backfilling, compacting, disposing of surplus and unsuitable material, and restoring existing areas.

**Electrical service** will be measured in units of each and will be paid for at the contract unit price per each. This price shall include service poles, safety switches or breaker boxes, service entrance conductor cables from the utility company's service box conductors to the safety switch and circuit breaker box, conduit and fittings on poles and steel supports, conduit straps or clamps, meter bases, grounding equipment,

service entrance heads, thimbleye bolts steel supports, wireway, excavating and concrete and pickup and installation of meter base and current transformer cabinet.

**Luminaire arms** will be measured in units of each and will be paid for at the contract unit price per each. This price shall include slipfitters, fittings, and mounting hardware.

**Lighting poles** will be measured in units of each and will be paid for at the contract unit price per each. This price shall include pole shafts, luminaire arms, grounding lugs, hand holes and covers, caps, identification tags, anchor bases, bolt covers, bracket arms, and breakaway support systems.

**Signal poles** will be measured in units of each and will be paid for at the contract unit price per each. This price shall include pole shafts, mast arms, grounding lugs, hand holes and covers, caps, fittings, anchor bases, bolt covers, and identification tags.

**Overhead and bridge-mounted sign structures** will be measured in units of each and will be paid for at the contract unit price per each. This price shall include structural units and supports, hand holes and covers, grounding lugs, walkways and handrails, electrical systems including conduit and fittings, and identification tags.

**Sign posts** will be measured in linear feet and will be paid for at the contract unit price per linear foot. This price shall include clamps, identification tags, and breakaway base assemblies.

**Pedestal poles** will be measured in units of each and will be paid for at the contract unit price per each. This price shall include caps, breakaway support systems, hand holes and covers, grounding lugs, identification tags, and anchor bases and bolt covers.

**Wood poles** will be measured in units of each and will be paid for at the contract unit price per each. This price shall include thimbleye bolts, guy wires with guards and anchors, excavating, backfilling, compacting, disposing of surplus and unsuitable material, and restoring existing areas.

**Conductor cables** will be measured in linear feet and will be paid for at the contract unit price per linear foot. This price shall include conductors, breakaway connections, markings and identifications, splice kits, electrical tape, testing, and connections.

**Conduit** will be measured in linear feet and will be paid for at the contract unit price per linear foot. This price shall include conduit bodies, fittings, bonding systems, pull ropes, plastic spacers, pull or splice boxes with an area of 512 cubic inches or less, supports, and protective metal shields.

**Trench excavation** will be measured in linear feet and will be paid for at the contract unit price per linear foot. This price shall include trenching, encasing, backfilling, locator tape, compacting, disposing of surplus and unsuitable material, and restoring existing areas.

**Junction boxes** will be measured in units of each and will be paid for at the contract unit price per each. This price shall include concrete collars, frames and covers, tools to remove the cover, ground rods, ground conductors, grounding lugs, knockouts, cable racks, aggregate, excavating, backfilling, compacting, disposing of surplus and unsuitable material, and restoring existing areas.

These prices shall include providing the required finish.

**Test bores** will be measured in units of each and will be paid for at the contract unit price per each. This price shall include the test bore, rock sampling and determination of the soil and rock condition.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
Concrete foundation (Standard, type, and size)	Each or cubic yards
Electrical service (Standard and type)	Each
Luminaire arm (Length)	Each
Lighting pole (Standard, luminaire mounting height, and length of luminaire arm)	Each
Signal pole (Standard, length, number, and length of arms)	Each
Overhead sign structure (Location)	Each
Bridge-mounted sign structure (Location)	Each
Sign post (Type and size)	Linear foot
Pedestal pole (Standard and length)	Each
Wood pole (Class and length)	Each
Conductor cable (Size/number)	Linear foot
Conduit (Type and size)	Linear foot
Trench excavation (Standard)	Linear foot
Junction box (Standard)	Each
Test bore	Each

## SECTION 701—TRAFFIC SIGNS

### 701.01—Description.

This work shall consist of furnishing, fabricating, refurbishing and erecting signs as specified on the plans.

### 701.02—Materials.

Reflective sheeting shall conform to the requirements of Section 247.